632.B

RESTRICTED - FOR ADMINISTRATIVE USE ONLY

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
Division of Insecticide Investigations

Project I-c-1-15 Date January 27, 1953 Author F. B. Knight

TITLE

SPECIAL REPORT FC-3

BLACK HILLS BEETLE POPULATION STUDY

Fort Collins, Colorado

This report is not for publication in whole or in part without prior approval by the Chief of this Bureau.

U. S. GOVERNMENT PRINTING OFFICE 16—47272-1

SPECIAL REPORT FC-3

BLACK HILLS BEETLE POPULATION STUDY

F. B. Knight

SUMMARY

A study was designed and commenced during 1952 for predicting trends in Black Hills beetle (Dendroctonus ponderosae Hopk.) infestations by means of counting the insect populations in beetle-killed ponderosa pines.

Two 240-acre plots were established during 1952 on the Roosevelt National Forest. Using data obtained from 25 trees sampled on each plot it was found that to obtain accuracy within 10 percent it is necessary to take 50 population samples. These samples are the number of live insects under two 6 x 6 inch squares of bark cut at d. b. h., one on the north exposure, one on the south exposure, of each of 25 infested trees within the plot. The data should be collected in late April or early May in the Central Rocky Mountain areas.

REPORT

Objectives

The purpose of this study of Black Hills beetle populations is to determine whether a method can be developed whereby predictions can be made of current trends in Black Hills beetle infestations. Such predictions could be used to determine those outbreak areas where naturally decreasing populations obviate the need of control.

The objectives of the first year of field work were to establish two permanent plots and, from the measurement of the populations in several trees from each plot, to determine the number of trees and the size of sample needed from each tree to obtain a population figure with a mean sampling error of approximately 10 percent.

In the discussion included in this report the word "population" is mentioned many times. The population referred to in this study is the average number of live beetles to be found in a sample at breast height. No attempt will be made to determine the total population of beetles in a tree nor of the population average for samples taken at random within the infested portion of the bole. As a hypothesis for the study it is assumed that trends in total populations of infestation areas or trees are reflected in the average populations within small samples at breast height.

Field procedure

Two 240-acre plots were established within infested areas on the Roosevelt National Forest during April of 1952. The plots are rectangular but not identical in shape because of the topography and timber types. All of the

1950 "red-topped" trees and the 1951-infested trees were counted (Table 1) and their approximate locations recorded. Each subsequent year during the study a count of the infested trees will be made on the plots.

During late April and early May counts of beetle populations were made on 25 trees from each plot. April or May seem most feasible for sampling because much of the natural mortality due to cold weather and other factors has occurred and insect emergence has not commenced. Also, for practical application the readings should be taken just prior to the normal period for control work. All living insects were counted under sections of bark cut from the trees at breast height. Counts were made under 3 x 6, 6 x 6, and 6 x 12 inch samples on both the north and the south exposures of each tree.

Analysis of data

The standard error of the mean was computed for each sample size and exposure (Table 2). An analysis of the data in Table 2 showed no significant difference between sample sizes and no significant differences in samples obtained from the north or south exposures.

Using the formula $N = \frac{Vy}{(0.1 \cdot \bar{y})^2}$ the number of samples of each sample size needed to obtain a sampling error of 10 percent at the 68-percent level was computed. In the formula, N is the number of samples needed, $\bar{y}$ is the mean number of live insects for the sample size and Vy is the variance of a sample. The number of samples needed for each sample size is: 3 x 6, 60; 6 x 6, 50; and 6 x 12, 39. In the field the data can be obtained from 50 samples of 6 x 6 size faster than from 39 samples of 6 x 12 size; therefore, the 6 x 6 size is better than the 6 x 12 size. Also, the time required to take counts from 50 6 x 6 samples is faster than that required to take counts from 60 3 x 6 samples considering time required to travel from tree to tree and to record other data. Because of these facts and the analysis showing actually no significant differences between sample sizes, the 6 x 6 sample size will be used throughout the study.

By sampling from 25 trees a good distribution of trees within the plot can be obtained. Since 50 samples are needed and in some plots there may be less than 50 trees, more than one sample must come from a tree. No significant difference was found between exposures, hence to assure uniformity of sampling two samples will be taken from each of 25 trees in each plot; one 6 x 6 sample will be taken from the north side and one from the south side.

Using data already available for plots one and two, meeting the above sampling requirements, computations of the sampling errors were made, Table 3. The requirements of approximately a 10-percent sampling error were met.

In addition to population counts the number of inches of parent adult gallery was recorded for each sample. The variation in lengths was found to be much less than the variation in populations. (Sampling errors are shown in Table 4). In succeeding years the number of attacks found in each sample also will be recorded. The diameters at breast height of the sample trees are recorded.

A summary of the data collected during 1952 is shown in Table 5. These are the data that will be used together with data from succeeding years in finding a method for predicting trends.

APPENDIX

Table 1. Measurements recorded on two 240-acre plots established during 1952, Black Hills beetle population study

Plot	Shape (chains)	1950-Attacked Trees (number)	1951-Attacked Trees (number)
1. Redfeather Dist.	30 x 80	101	37
2. Poudre Dist.	40 x 60	800	267

Table 2. Sampling errors in percent based on number of insects for each sample size and exposure, mean of 25 samples

Plot	Exposure	3 x 6 (percent)	6 x 6 (percent)	6 x 12 (percent)
1	North	14	12	12
	South	18	18	14
2	North	15	15	15
	South	12	12	12

Table 3. Sampling errors in percent, based on number of insects per 6 x 6 sample size, mean of 50 samples

Plot	Sampling Error (percent)
1	11
2	10

Table 4. Sampling errors in percent, based on inches of parent adult gallery per 6 x 6 inch sample, mean of 25 samples

Plot	North Exposure (percent)	South Exposure (percent)
1	9	10
2	6	6

Table 5. Population study data from Plots 1 and 2, 1952 data based on 50 6 x 6 inch samples from 25 trees

	6" x 6" Sample		Trees	
	Insects	Inches of Gallery	Mean Diameter	Number Attacked in 1951
1	27 ± 2.9	21.5 ± 1.5	9.4	37
2	23.5 ± 2.3	25.5 ± 1.1	12.0	267

cc: Beal, All Stations, Prof. Schumacher, Knight